

INSIDE THIS ISSUE: ENGINEERING MATERIALS

Engineering
Materials

MAGAZINE

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November 2019

DESIGN | INNOVATE | ENGINEER

Eureka!



DIGITAL DIVIDENDS

HOW THE DIGITAL CATAPULT IS HELPING INDUSTRY TO EMBRACE NEW DESIGN OPPORTUNITIES

IN THIS
ISSUE

P19
LOCKED INTO
CLAMPING

P22
INSPECTION
WITH AI

P36
ALL THE
GEAR...

P38
BEEAS 10TH
ANNIVERSARY



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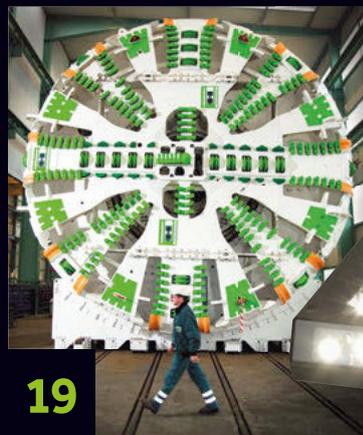
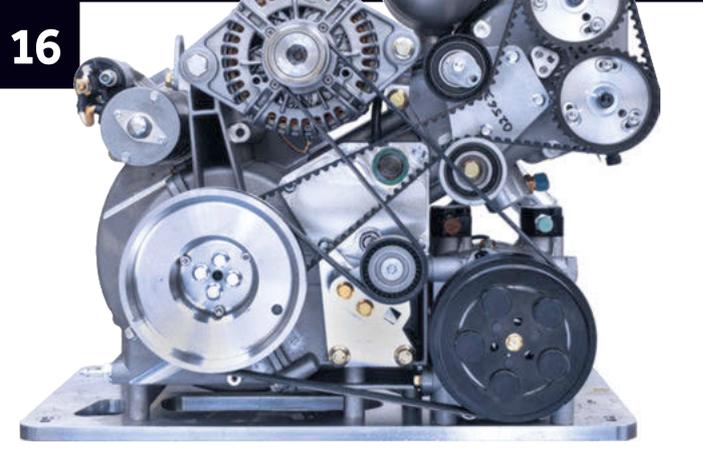
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05 COMMENT

A lot has changed over the last 10 years, but the BEEAs still celebrate all that is best in British engineering.

06 NEWS

- Start-up wows BEEAs
- 200-year-old scrolls decoded
- Hyundai exoskeleton
- Lontra opens purpose-built centre

10 COVER STORY REAPING THE DIGITAL DIVIDEND

How do we embrace the opportunities presented by digital technology? The Digital Catapult offers some answers.

14 ON THE TOPIC OF... STAR QUALITY

After so much recognition, Jaguar Land Rover's Orla Murphy shows no sign of losing any of her passion.

INSIDE

Winter 2019 | Eureka Magazine

Engineering Materials

HELPING INDUSTRY FIND THE RIGHT MATERIAL FOR THE RIGHT APPLICATION

32

Tunable bioplastics

30

High Speed Welding

WWW.MATERIALSOFENGINEERING.CO.UK

29 Round-up

30 Welding: High-speed welding

33 Plastics: Tuneable bioplastics

16 ADDITIVE MANUFACTURING PRIORITISING PRODUCTION

A new prototyping method, based on prioritising final production, can speed time to market and reduce costs.

19 ADHESIVES LOCKED IN

How to achieve the best clamp load retention performance in extreme conditions.

22 SENSORS I SPY WITH MY UVEYE

A system for detecting explosives underneath vehicles has been re-designed for automotive quality assurance.

24 MOTORS FUTURE-PROOFING MOTOR MANAGEMENT

As technology gets smarter and Industry 4.0 becomes a reality manufacturers need to move with the times.

36 POWER TRANSMISSION ALL THE GEAR...

A review of some of the latest gearbox technologies that have reached the market that increase performance and efficiency.

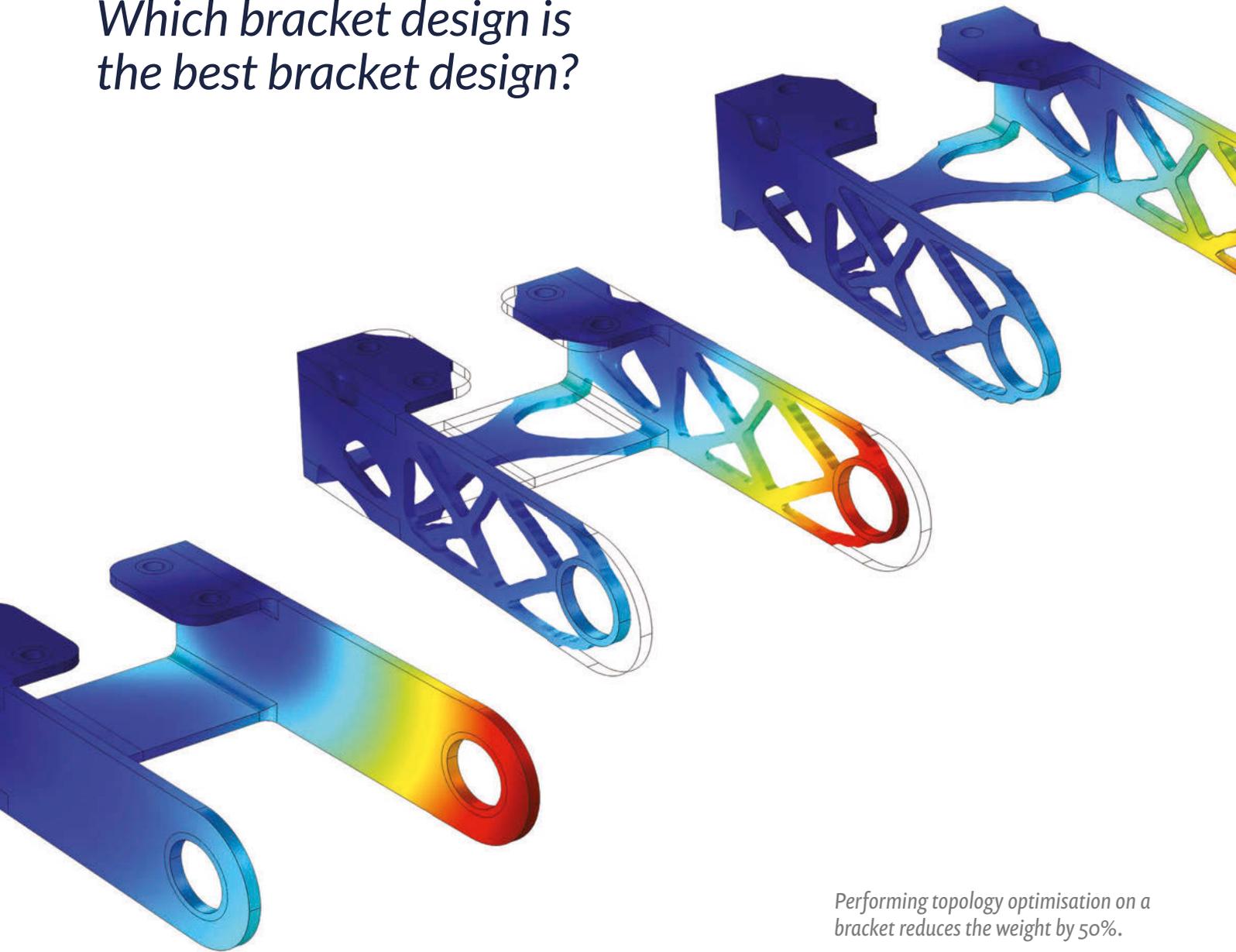
38 BEEAS 10TH ANNIVERSARY A DECADE OF EXCELLENCE

Over the last decade the BEEAs has grown in stature along with the innovative products, and standout start-ups, OEMs and individuals that have been nominated.

43 COFFEE TIME CHALLENGE HOUSING CRISIS

With 5.9 million refugees in the world today – and that number only set to rise – this month's challenge is to design a semi-permanent dwelling to increase the quality of life of displaced peoples.

Which bracket design is the best bracket design?



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BEEA HAPPY

A LOT CAN happen in 10 years and, from the perspective of the British Engineering Excellence Awards, a lot has happened.

Over that decade, we've enjoyed ten ceremonies, congratulated nearly 1,000 entrants and presented more than 100 winners with their trophies.

Over the years, the locations, faces and even the shape of the trophies have changed. What has not, however, is the fundamental purpose of these awards: to celebrate all that is best, most innovative and most deserving of praise and recognition in British engineering.

That's easily said, of course, but having been involved in most of the judging over the last decade I can bear witness that the rigour and laser-like focus on excellence that was there in 2009 was certainly still there a few weeks ago when the judges met.

The crop of winners in 2019 stands comparison with any year of the last decade. From the SC+ system that promises to transform the lives of those who need dialysis to the Grand Prix winner Automata that has brought effective automation and robotics within the budget of SMEs for whom such systems have previously been unaffordable, excellence, as ever, has been the watchword.

Nowhere is this more the case than in the winner of the special 'Design Engineer of the Decade' award, which saw every previous Design Engineer of the Year pitted against one another. Sebastien Cuvelier Mussalien's work has been



outstanding and he is a worthy winner.

Sebastien is kind enough to credit winning the BEEAs in 2013 with giving him the confidence to start his own consultancy. To some extent, that win was a transformational event for him. This is not a question of claiming credit, however, but simply highlighting what the BEEAs were always meant to do.

That is what the BEEAs were started for and that's why they continue. We hope the BEEAs always retain that power.

Paul Fanning, Editor

MISSION STATEMENT

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Eureka! connects design engineers with the UK's industrial heartbeat by providing in-depth coverage on the very latest technology developments and industry trends; keeping you inspired, informed and innovative.



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ROBOTICS STARTUP

AUTOMATA has been awarded the Grand Prix at the 2019 British Engineering Excellence Awards (BEEAs), held at The Landmark, London on 11 October.

Founded in 2014 by architects Mostafa ElSayed and Suryansh Chandra, Automata was born out of the need to find a cost-effective approach to industrial automation when the only options available were prohibitively expensive industrial robots, or basic robot arms that are little more than toys.

The company's Eva robot

is affordable and easy-to-use, while also being fit-for-purpose in an industrial context. Having launched commercially in March 2019, the company has surpassed 150+ orders, with many successful deployments for customers who are now making repeat multi-unit orders.

This was the 10th anniversary of the BEEAs, in honour of which, a Design Engineer of the Decade category was awarded. This saw every previous winner of Design Engineer of the Year pitted against one another to decide on 'the best of the best'. The winner of this prestigious prize was Sebastien

Cuvelier Mussalian, who won in 2013 for his work as lead engineer on the OrganOx perfusion system, which keeps donor human livers 'alive' before being transplanted.

Since then, Sebastien has gone on to build an international reputation for the design, development and industrialisation of innovative, robust medical devices. The judges were keen to recognise his contribution to the industry; his ability to handle complex, multidisciplinary projects; and the truly global impact of his work.

For the full run-down of category winners, turn to page 38.

TECH BRIEF

MATLAB AND SIMULINK 2019b

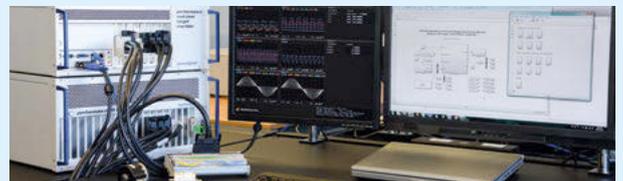
MathWorks has introduced Release 2019b with a range of new capabilities in MATLAB and Simulink, including support for AI, deep learning and the automotive industry.

In addition, it introduces products supporting robotics, new training resources for event-based modelling, and updates and bug fixes across MATLAB and Simulink.

Among the MATLAB highlights in R2019b is the introduction of Live Editor Tasks, which enables users

to interactively explore parameters, pre-process data, and generate MATLAB code that becomes part of the live script. Now, MATLAB users can focus on the task instead of the syntax or complex code, and automatically run generated code to iterate on parameters

through visualisation. R2019b highlights in Simulink include the new Simulink Toolstrip, which helps users access and discover capabilities. Here, tabs are arranged according to workflow and sorted by frequency of use, saving navigation and search time.



2000-year-old scrolls decoded at Diamond

DIAMOND LIGHT SOURCE

in Oxfordshire, will play a key role in examining and 'virtually unwrapping' the Herculeum Scrolls that were buried and damaged in the volcanic eruption of Mount Vesuvius.

According to Professor Brent Seales, director of the Digital Restoration Initiative at the University of Kentucky: "Texts from the ancient world are rare and precious, and cannot be revealed through any other known process."

Buried and carbonised by the eruption in AD 79, the scrolls are too fragile to be opened and represent a perfect storm



of important content, massive damage, extreme fragility, and difficult-to-detect ink.

"We don't expect to see the text from the upcoming scans, but they will provide the crucial building blocks for enabling that visualisation," said Prof Seales.

Principle Beamline Scientist on the Diamond I12 Beamline where the experiment will take place, Dr Thomas Connolly, added: "We are very excited to play our part in what we hope will be a major step forward in unlocking the scrolls' secrets."

HYUNDAI EXOSKELETON

HYUNDAI MOTOR GROUP

has developed the Vest EXoskeleton (VEX), a wearable robot created to assist industrial workers who spend long hours working in overhead environments.

The VEX is said to enhance productivity and reduce fatigue of industrial workers by imitating the movement of human joints to boost load support and mobility.

"VEX gives workers greater load support, mobility, and

adaptability when operating in overhead environments," said DongJin Hyun, head of Robotics team of Hyundai Motor Group. "Workers will also appreciate how light VEX is to wear and work with."

Weighing 2.5kg, the VEX is 22-42% less than competing products and is worn like a backpack. The back section can adjust in length by up to 18cm to fit a variety of body sizes, while the degree of force assistance can be adjusted over six levels –

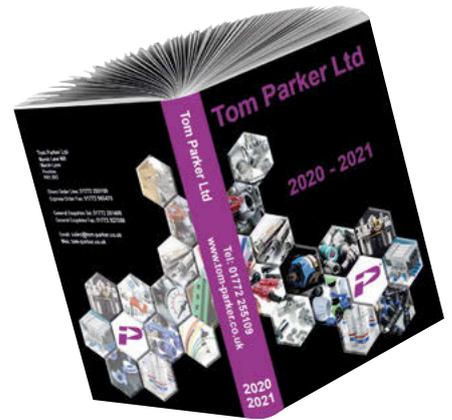
up to as much as 5.5kg-force.

The VEX is targeted at production-line workers whose job is primarily overhead, such as those bolting the underside of vehicles, fitting brake tubes, and attaching exhausts.

As part of the Group's plans to develop a diverse range of robotics technologies, another lightweight wearable device is being developed. The 'Chairless EXoskeleton' (CEX) supports workers to maintain a sitting position without a stool or chair.



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SOLUTION TO LAST MONTH'S COFFEE TIME CHALLENGE



Lontra opens new centre

LONTRA, HAS OPENED its first purpose-built advanced manufacturing centre in Napton, Warwickshire, in partnership with Shield Group Engineering.

This is touted as the first phase of expansion driven by exports where Lontra is seeking to develop several advanced manufacturing centres, a global technology centre, assembly facilities and a revolutionary digitally driven services centre in the Midlands, the North and London. Currently 80% of Lontra's products, manufacturing and services can be exported from the UK to key markets including the US and UAE

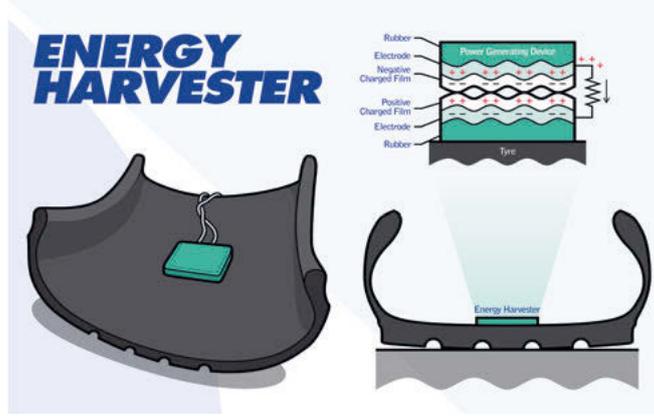
Steve Lindsey, CEO and Founder at Lontra said: "Lontra is now incredibly well-positioned to address the €69bn global market for compressed air solutions and we continue to develop high value and exportable technologies, products and services."

Last month we challenged you to come up with a way of powering hybrid and electric vehicles – or simply just certain components of them – by completely renewable methods, cutting out doubt over the 'greenness' of the power generated to run them.

Our solution comes from Falken Tyre's parent company, Sumitomo Rubber Industries, and Professor Hiroshi Tani of Kansai University. Together they have developed a technology that could see tyres generate electricity whilst driving.

The Energy Harvester takes advantage of the build-up of static electricity, known as frictional charging, to produce power as the tyre turns.

Inside the Energy Harvester are two layers of rubber each



covered in an electrode, along with a negatively charged film that interfaces with a positively charged film. When fixed to the inside of a conventional tyre carcass it generates electricity as the tyre deforms during rotation.

The engineers believe the Energy Harvester could lead to practical applications as a power source for sensors used in TPMS (Tyre Pressure Monitoring Systems) and other automotive devices without the need for batteries.



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3D SOLIDWORKS

REAPING THE DIGITAL DIVIDEND

We all know we need to embrace the opportunities presented by digital technology, but how do we do it? The Digital Catapult offers some answers.

When asked if they're keen to embrace digital opportunities, most engineering concerns would answer in the affirmative. However, the problem that generally arises is how to actually achieve that. Where does one start? What technologies are appropriate? Who can one work with?

Answering these questions was one of the reasons for the establishment of the Digital Catapult. Digital Catapult is the UK's leading advanced digital technology innovation centre. It drives the early adoption of digital technologies to make UK businesses more competitive and productive to grow the country's economy.

Since its launch in 2013, the Digital Catapult has made significant progress in helping grow the UK's economy. It has opened five centres across the UK, worked with over 2,500 start-ups and scale-ups to take their business to the next level, won over £3.5m in collaborative R&D bids and partnered with a number of major corporates to support their open innovation work including Visa, Cisco and PWC. It has also helped deliver 41 projects and generate additional contributions of £5m from across the technology landscape.

It does this in several ways. The first is by providing physical and digital facilities for experimentation and testing that would otherwise not be accessible for smaller companies. Its

Digital Catapult is the UK's leading advanced digital technology innovation centre. It drives the early adoption of digital technologies to make UK businesses more competitive and productive to grow the country's economy

innovation programmes drive collaboration and encourage use of the facilities. By bringing together small companies, corporates, researchers and investors, the right solutions are developed to solve industry challenges, increase productivity and open up new markets faster.

It also connects corporations, small businesses and academic researchers to get the latest thinking into the heart of industry and discover new ways to solve big challenges in the manufacturing and creative industries.

"We've really done two different things," says CEO Jeremy Silver. "One is to think about which industrial sectors to put the most focus on – not necessarily exclusively, but the most focus. And on the other hand, what are the technologies that we will be working with? When we did the analysis across what the opportunities for UK businesses looked like, there were two sectors that jumped out in relation to what you might call a digital opportunity. One of those is the creative industries, which are very strong in the UK, but the other one that jumped out was manufacturing. When you look at that sector as a whole, and you think about what the digital multiplier would add up to, it comes out much higher than anybody else. I think we are possibly the only organisation that has decided that the creative industries and manufacturing should sit side by side as bedfellows

in some respects, because there are actually all sorts of interesting crossovers between them. So that's one way that we think about the world."

The other process the Catapult has gone through is to think in terms of the technologies themselves and focus on three key areas. These are: artificial intelligence and machine learning; future networks; and immersive technology such as VR and AR.

Silver adds: "Obviously, digital means everything and nothing these days. But for us, the focus is on the more advanced and digital technologies, which are also the most hyped and the most susceptible to the Gartner hype cycle. At the same time, they're also potentially the ones that need more testing and more proving."

Naturally, some of this is in association with academia. "In artificial intelligence and machine learning, the UK's strength is its deep tech sector, with people coming not just from Imperial and Cambridge, but also from centres like Newcastle and Edinburgh as well," says Silver.

Again, when it comes to immersive technologies, the UK's strength lies in the application of these technologies. "We have a focus, too, on immersive technologies like virtual reality," says Silver. "Here the UK's strength is not in the hardware, or the headsets or controllers, it's in the content and in the applications that can be brought to bear and all sorts of interesting opportunities. In industry, they're not just in entertainment. And we're already

JEREMY SILVER

Jeremy Silver is CEO of Digital Catapult. He is an author, angel-investor and entrepreneur specialising in virtual and augmented reality, AI, music and the creative industries.





seeing in the advanced automotive sector the use of augmented reality for design purposes and product design. This is really changing the proposition for designers and speeding up the process, allowing people to be more flexible because they can envisage things very quickly and visualise things very quickly to make very rapid changes in a way that was previously much more difficult to achieve.”

So how does this collaboration actually take place? “What we do with the way that we work, is really to spend a lot of time engaging with a whole range of stakeholders,” says Silver. “We have a very privileged place in the landscape because we sit between universities and academia. We’re close to government, but we’re not of government. We’re a private company and we’re able to work in a more commercial way.”

The Catapult works with traditional industries and spends a lot of time engaging with the ecosystem of startup and early- »



» stage businesses in those specialist technology areas. Says Silver: “When we talked to them all on a regular basis, we’re really trying to figure out with them, what are the things that are holding them back. And what are the things that we could build – what kinds of environments can be created – that would allow them to move forward more quickly and overcome some of those barriers and find ways of collaborating better?”

The creation of environments – be they digital spaces, physical spaces, test beds and networks in which people can both experiment and try applications of technology out – is key to the Catapult’s role. This is in part because it allows participants to collaborate with people that they wouldn’t otherwise get to meet with. “That might be small companies working with traditional players; it may be academics coming to play with startups; or it may just be people from entirely different disciplines in technology, especially service coming together around projects. So, we run and create facilities of that kind,” says Silver.

But building facilities on their own isn’t enough, according to Silver. “What you do need to do is to build programmes and create innovation environments. And that’s

the other place where we’ve developed some expertise and I think are different from some of the other accelerators and incubators, because we’re so very specific, both in the physical environment and the digital environment that we offer to work in. But also, there is a real focus on particular areas of technology and applications,” he says.

The results speak for themselves. Says Silver: “We’re very fortunate in that we’ve been able to work with around 300 or 400 early-stage companies a year in really close proximity to our programmes. In the last 12 months, we’ve had about 90 companies raise over £100 million between them. And that’s a real measure of success for us. So, when we think about how do we know whether we’re making a difference or not, it’s whether the companies that we’re working with are growing and adding employees? Are they bringing new products to market? Are they making long term contracts with traditional businesses? And are they getting private investment?”

“Everything we’re trying to do with them is to find ways of

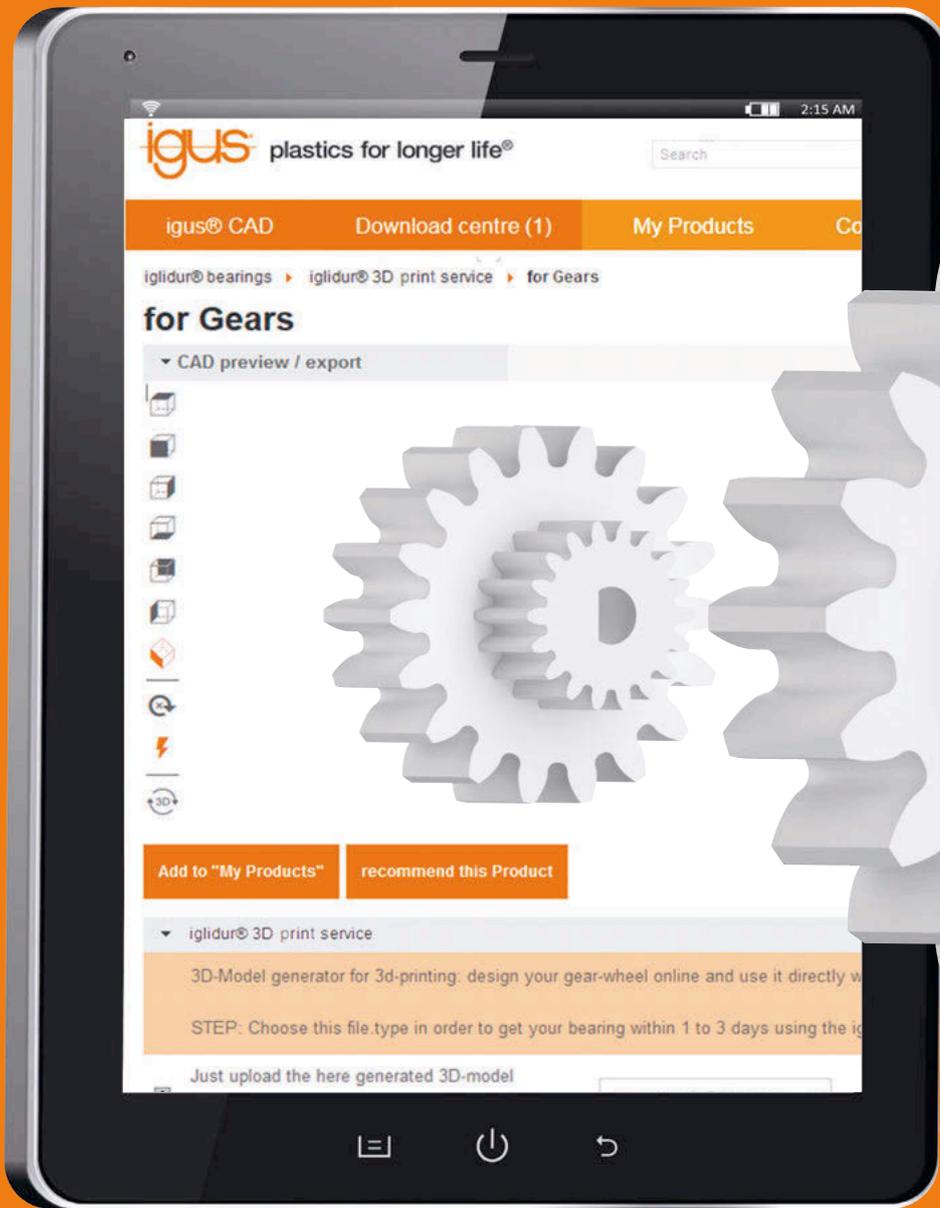
“We’re very fortunate in that we’ve been able to work with around 300 or 400 early-stage companies a year in really close proximity to our programmes. In the last 12 months, we’ve had about 90 companies raise over £100 million pounds between them”

demonstrating a great way of making this technology work and here’s an application area that you can develop and deploy in other contexts.”

In the longer term, Silver sees the Digital Catapult as playing a crucial role in the long-term success of the UK’s engineering sector. “There’s no question that the way we attract people to the UK is by bringing together that combination of academic strength, but of capability of the kind that we’re really trying to develop, which is how to take that expertise that comes out the research base, and really make it real in a commercial environment.”

On a personal level, he says: “The thing that I find the most exciting is can we get the kind of the energy and the innovation that you find in start-up businesses, and make sure that they’re really sustainable and can grow in the longer term and then infect and contaminate traditional businesses in a way that allows them to develop and change rapidly as well. If we can bring those two kind of forces together, then there’s enormous opportunity there. And that’s what we’re all about.” 

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With an array of top awards to show for what is still a relatively short career in engineering, Orla Murphy of Jaguar Land Rover shows no sign of losing any of her passion for the profession, as Paul Fanning reports.

When you ask engineers how they got into the profession, they often suggest that their career path was virtually pre-ordained, giving every impression of never having really thought of pursuing any other path than the one dictated by their vocation.

Recently promoted to Software Change Robustness Manager at Jaguar Land Rover, Orla Murphy's story isn't quite like that. Raised the daughter of Cork dairy farmers, she showed an early talent for maths and physics, but also for music. Only when she took part in the BT Young Scientist Competition at the RDS, Dublin and won best overall maths, physics and chemistry project, did her future career come into sharper focus.

"Engineering wasn't on my radar," she says. "It was not visible to me or something I had really considered... All I know is that I didn't have any exposure to the possibilities of an engineering career until very late on in my teens."

The change came when she found out about a degree course in Electronic Engineering with Music at Glasgow University. "They described the degree as one third physics, one third maths and one third music. It seemed like it was made for me," she says. From here, she went on to do her master's before taking internships first with BT and then with Jaguar Land Rover.



"When I went for the internship," she says, "I told them 'I'm not a car person. I don't love cars, but I know that sound, music and acoustics are going to be very important areas within cars and that's the area I wanted to work in. So, then I was placed with the audio calibration team and I had a six-month project as an intern creating 3D surround sound, putting speakers in the roof of the vehicle and conducting listening tests."

She came back to Jaguar Land Rover on its graduate scheme and the first few roles she held at Jaguar Land Rover were on the audio side. However, the graduate scheme involved placements around the business in manufacturing, quality, CAD and even public relations.





She also became heavily involved with the quality side, attaining her green and the black belts. This culminated in a promotion to lead engineer in the electrical quality team, working as a 'black belt' working on problem-solving for the whole electrical department.

Another promotion followed to manager of the Product Engineering Quality team. "I'd gone from the audio team, to the electrical team to the entire vehicle team," she says. Recently, she started a completely new role as Software Change Robustness Manager.

This variety and necessary adaptability is something she

"I told them 'I'm not a car person. I don't love cars, but I know that sound, music and acoustics within the car are going to be very important areas within cars and that's the area I wanted to work in'"

relishes about being an engineer. She says: "I've always enjoyed learning new things. I'd hate to do a job where you work and work for years to learn how to do something and then it's always doing the same thing and you're always the same for the rest of your professional life. Oh, my god! That sounds horrendous to me, because literally your job on the first day is the same as your job the day you retire."

In engineering, she says: "Because you're engineering new projects all the time, your job is going to change constantly, and you have to be able to adapt. So, a lot of what I've learned in terms of the problem solving is broad and adaptable. You learn to be a good problem-solver and that's a skill you can apply to almost any project. You can work in any company, any industry."

To say Murphy's time with Jaguar Land Rover has been a success would be something of an understatement. Since joining in 2012 she has been made IET Young Woman Engineer of the Year in 2015; the Royal Academy of Engineering's Engineer of the Year in the same year; was listed as one of The Daily Telegraph's Top 50 Women in Engineering in 2017 and was Design Engineer of the Year at

the British Engineering Excellence Awards in 2018.

She embraces her role as an ambassador for her profession – especially hoping to bring other young women into it. She says: "I was one of just two women on my course. We had some open days coming up and I volunteered to host them. I really wanted to show

people what was so good about this degree. Many of the girls who were applying were so pleased to have a girl to show them round because they'd assumed it would be completely male."

She believes that one of the biggest obstacles in getting young women into engineering is that they fear that they'll be the only girl there and that they'll be treated differently. "I think the lightbulb went off when I was doing the tours at the university,"



she says. "It wasn't even the girls; it was their parents saying 'Should she be doing engineering? It'll be so male dominated. She should do maths instead.' And if your parents are saying that, what chance do you have?"

Murphy is careful, however, to avoid being pigeonholed by her gender. "I never want to walk into a school or a room and say 'I'm a woman engineer'. I just want to go in and say 'I'm an engineer, this is my job and it's really exciting!' and not mention the woman thing at all.

Recently, Murphy has taken on a new role at Jaguar Land Rover which concentrates more on the electrical side of vehicles. She says: "I have an electrical background and then I moved to the vehicle engineering department. Now, electrical is growing so much and so quickly in the automotive sector. And this brings with it problems, especially with software, since the difficulty is how we manage and maintain software throughout the vehicle's life. There are so many elements to the car, all of which need to talk to each other and depend on each other. My role will be looking at software complexity and management in the field."

This new role will not stop her activities promoting engineering as a career, however. "I think it's great experience and it's easy to make a big difference by doing just a little bit," she says. 📌

PRIORITISING PRODUCTION

In this article Alan Francis examines the pitfalls of traditional prototype manufacture, and discusses why a new method, based on prioritising final production can both speed up time to market and reduce costs.

The importance of accurate prototype manufacture cannot be overstated. The subject of detailed testing and performance validation, a prototype part reveals whether any further design modification is needed, as well as providing vital data on the part's published performance attributes, warranties and service intervals. For these reasons, it needs to be the best part you ever make.

Unfortunately, production prototypes are often expensive, and approaches to their development have not always kept pace with other areas of design, engineering and manufacture.

The accurate manufacture of prototype parts and assemblies is vital for almost every engineering sector. In most instances, the prototype will be the only component subjected to every testing and performance validation procedure, which ultimately influences key decisions on design modifications, published performance attributes, warranties and service intervals.

At this stage, consistency and accurate process documentation are key. In the testing stage, for example, it's important for prototypes to remain as faithful to the original design as possible. Any deviations – whether in shape, thickness or material – can render test results unreliable, or even invalid.

These results are vital to the progression of a design, which is why they need to be as accurate as possible. If not, individual parts, or even the whole assemblies, must

be examined, remanufactured and reconfigured, all of which can lead to substantial delays and additional costs. Worse still, if inaccurate data is carried forward into the next stage of production, the ramifications can be severe: from a shortened service life or a failure to meet warranted standards, to a catastrophic failure while in service. For these reasons, a prototype must be the best and most accurate part a company ever produces.

THE PROBLEM WITH PROTOTYPING

Unfortunately, this field has not always received the attention it deserves. This could be for a variety of reasons. For one, production prototypes are often expensive, particularly when you compare it to the cost-per-unit of the component in its final form. There has also, arguably, been an inconsistent approach to prototype development, which has meant that it has not kept pace with its design, engineering and manufacturing counterparts.

Unlike the mass-production of finished parts - which involves detailed operations sheets, photos, precise written instructions and guidance on correct handling and fixing – prototype assembly often works based on a CAD representation at best. As a result, quality and repeatability can suffer. With most projects working to strict deadlines, re-engineering a component at a later stage incurs project delays and budget overruns

Why, then, has the manufacture of prototypes been so neglected?

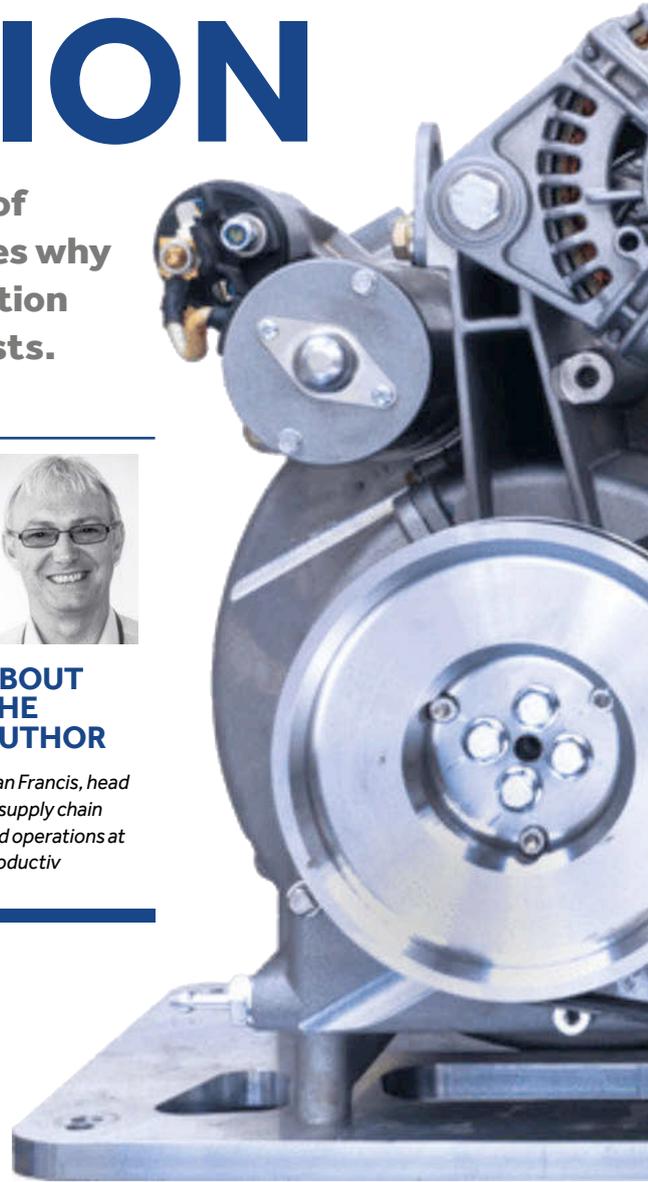


ABOUT THE AUTHOR

Alan Francis, head of supply chain and operations at Productiv

Traditionally, prototypes have been prioritised and progressed according to timeframe. Product development and project managers tend to focus on ensuring that all the required components are available by a certain date. In the worst cases, only once the components have arrived do engineers start worrying about how, and indeed whether, these components will fit together.

The number of tolerance and assembly issues identified at this stage is higher than many would care to admit. Fixturing can also cause problems, because investment in adequate workholding equipment





It's important for prototypes to remain as faithful to the original design as possible. Any deviations – whether in shape, thickness or material – can render test results unreliable, or even invalid

when adding remaining components is often the first to go in the drive to reduce project costs. This is, of course, a false economy: awkward working processes caused by incorrect fixturing can result in both damage to, and sub-standard assembly of, the prototype.

A SOLUTION TO THE PROTOTYPE PROBLEM

It's clear that prototype development needs a new approach. By focusing on wider objectives of getting a product to market and into production, the solution is challenging but achievable.

Each step in the prototype manufacture and assembly process must be driven by the objectives of final production. Overall risk, cost and time can be reduced, while increasing the chances of accurate production, reducing final assembly time and lowering the cost of re-work.

Production Oriented Prototyping (POP) is a novel approach to prototype development that involves both the individual component and full assembly designers from the start of the application development phase. The aim is to build production standards into the prototype, while minimising cost and delivery time, as

well as optimising safety.

Using virtual builds, simulation and validation via CAD, manufacturers can ensure that all the components fit together for each design release and can be accessed and manipulated during the build. Any issues with component compatibility, design or accessibility can be tackled at a much earlier stage and, crucially, before time and money have been invested in one-off component manufacture for the prototype.

Using this methodology, the team can develop operation sheets as they go, making the final assembly process easier and more intuitive. Fixturing and work-holding are also considered at an earlier stage, meaning that manufacturers have more time to specify and produce a

bespoke system, if required. This is especially true when dealing with larger or more complex assemblies, which do not lend themselves to easy movement or manipulation.

In effect, assembly process design – including process, flow, tooling and fixturing – is completed before the physical components are ready to be assembled.

By adopting this holistic approach, it's easier to identify and fix issues faster than would be achieved during final assembly, with programme time savings of over 25% often achievable. What's more, the extra efficiency afforded by POP allows assembly technicians to identify cost reduction opportunities for components and processes through 'practice runs' for future assembly.

Productiv has been developing and testing this method, and the results have been impressive. In one instance, we were able to reduce the assembly time for the first prototype build of a complex transmission for an automotive manufacturer from their typical eight weeks, to just eight days.

The benefits of the POP approach can be applied in any sector for which precision and replicability are vital to enable accurate testing and validation. In fact, any engineering business can achieve lower costs and a faster route to market. We hope this will finally give prototypes the attention they deserve. **!**

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LOCKED IN

How to achieve the best clamp load retention performance in extreme conditions.

Threaded assemblies are the most important detachable parts used in machinery construction, installation and repair. Relaxation of tension and self-loosening is common for any machine but when it is operating in harsh environments, the need to minimise this deterioration with effective threadlocking is even more important. Various methods are available but what are their respective strengths and failings? Mechanical devices such as

split pins and tab washers are only suitable for preventing the loss of nuts and bolts. Friction devices give some resistance to vibration but do not perform well under extreme conditions. Locking devices, such as tooth flanged and ribbed flanged bolts, nuts and washers are effective at preventing self-loosening but can damage the contact surface, need larger flange-bearing surfaces and are expensive.

Increasingly, threadlocking adhesives are taking the place of

traditional mechanical locking devices because they deliver the greatest all-round efficiency, especially when the going gets tough. As well as preventing unwanted movement, loosening, leaks and corrosion, they resist vibration. They are free-flowing liquids or semi-solid adhesives that completely fill the gaps between mating threads of fasteners and joints.

PROOF POSITIVE

To prove the performance of its threadlocking system against other methods, Loctite submitted its products for independent testing in a transverse shock and vibration machine in which pneumatic hammers force relative movement of the stressed parts. At the same time, the existing pre-stress force was continuously measured »

» for the number of load cycles. Characteristic clamp load retention curves of the various locking methods were then compared.

While a similarly favourable load cycle performance was provided by the ribbed flange bolt, it does have other disadvantages. It is expensive, requires a relatively large amount of space for the flange bearing and causes unavoidable damage to the surface of the clamped parts around the bolt bearing.

A bolt with a saw-toothed flange also performed well but its teeth penetrated the bearing's surface of the clamped material. The head and the nut were damaged during loosening, limiting their possible application to parts with hardened surfaces that cannot be reliably connected.

As well as performing well, the Loctite threadlockers are said to cut costs by replacing expensive special locking bolts or nuts, allowing less costly standard assemblies to be used.

IF IT'S GOOD ENOUGH FOR CROSSRAIL...

With such a good result for clamp load retention and cost efficiency, it is no wonder that when Herrenknecht AG was evaluating the best way to secure threaded assemblies on its tunnel boring machines for Crossrail it chose Loctite. It mainly uses Loctite 243 to lock bolts which must resist massive pressure as the machines eat into the sub-soil. This is a medium strength adhesive that is suitable for all metals including passive substrates.

And it's a similar story with Local Motors' Rally Fighter, high performance, off-road racing car that needs to withstand



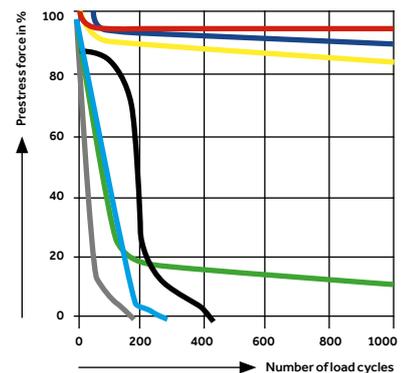
extreme conditions without constant maintenance. Cars like the Rally Fighter are subject to jarring bumps and vibration that shake loose even the sturdiest of nuts and bolts. By applying a Loctite threadlocker mechanics knew that once they tightened the bolt or screw, it would stay tightened, even in the toughest environments.

EXTENSIVE CHOICE

Loctite threadlocking adhesives are available in varying viscosities and strengths to meet the needs of a wide range of applications. They are single-component and semi-solid adhesives that cure at room temperature to a hard, solid thermoset plastic when applied between steel, aluminium, brass and most other metal surfaces.

Low strength formulations allow disassembly with standard hand tools and are ideal for adjustment screws, calibration screws, meters, gauges and for thread sizes up to M80. Medium strength provides a greater degree of performance and is good for machine tools, presses, pumps, compressors and gearboxes.

High strength products are used where frequent dismantling is unlikely and may require localised heat for removal, as do wicking compounds that are widely used for



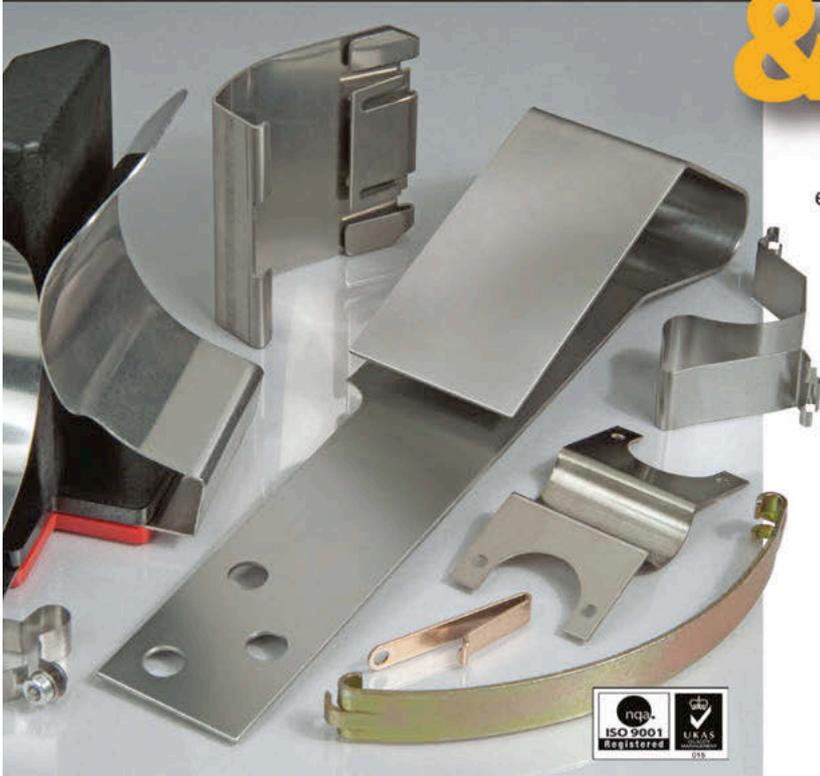
- Standard bolt with Loctite threadlocking system
- Adhesive bolt (ribbed flange bolt)
- Bolt with saw-toothed flange
- Nut with polyimide washer
- Bolt with DIN 6797 A tooth lock washer
- Bolt with DIN 127 A spring washer
- Unsecured standard bolt

pre-assembled fasteners.

Continuous development of Loctite threadlockers has greatly extended the application scope of these products. They are now much more effective on passive substrates such as stainless steel and their greater oil tolerance makes them less sensitive to improperly cleaned parts. And importantly, these qualities have been achieved without compromising any of the products' other key properties such as chemical resistance and shelf life.



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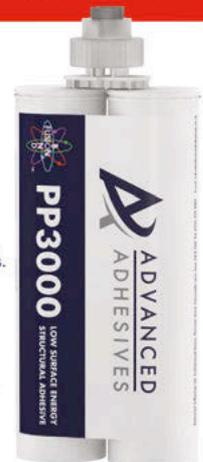
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I SPY WITH MY UVEYE

An Israeli start-up has taken a system for detecting explosives underneath vehicles and re-designed it for the automotive quality assurance market. Tom Austin-Morgan reports.

Brothers Amir and Ohad Hever founded UVEye in August 2016 after Amir had witnessed the manual inspection of vehicles for security threats. The traditional approach is for a security guard to circle a vehicle with a mirror on the end of a long pole to try and spot weapons or explosives. Besides the fact that this test is outdated and unreliable, most importantl, it is life-threatening.

UVEye, which stands for under vehicle eye, originally developed both a fixed and a mobile inspection system, called Helios, that automatically detects visual anomalies on the undercarriage of any vehicle. The fixed unit version is most suitable for facilities with permanent entrances where moving of the system is not required. The mobile version is designed especially for law enforcement agencies, security firms and intelligence organisations that need to scan passing vehicles easily and conveniently.

In less than 5 seconds Helios' inbuilt, hi-res, super-fast cameras scan the vehicle's underside capturing sharp, clear colour images from numerous angles and alerts operators immediately if it detects concealed items — be it threats, concealed weapons, or a human being.

The camera also enables the system to match each vehicle undercarriage footprint and store the information in a secure database

for later inquiry. This could be highly valuable information for border control where different border locations can share the data scanned by the system of a specific vehicle.

From the very first scan, it can automatically recognise and identify dubious objects without having any previous record of a vehicle. It can even compare between scans of the same vehicle model and detect whether any changes have been made.

David Oren, chief strategy officer at UVEye, says: "The technology we had to develop to do that was very advanced. We built our own AI

In less than 3 seconds, Helios' inbuilt, hi-res, super-fast LPR camera scans the vehicle's underside capturing sharp, clear 3D colour images from numerous angles

engine, deep learning, machine learning and computer vision into that.

"Once we started deploying those systems, very quickly we realised that almost the same technology, with just a small adjustment, could be able to detect various problems on vehicles in general, such as oil leakages; rust; corrosion; damage to the undercarriage."

Early in 2017, UVEye started working with automotive companies





the exterior of the vehicle to detect anomalies. These could include damage like dents, scratches, hail damage, alignment problems. Then we started working with OEMs, and big fleets until we reached the point today where UVeye is working with a few OEMs around the world for assembly line inspection, end-of-line inspection, some in-line inspection for parts, and we provide systems for the aftermarket."

This necessitated the development of Atlas, UVeye's 360° exterior inspection system. More recently the company announced, Artemis, a tyre inspection system. This is able to detect under-inflation and any other anomalies that can become a serious safety concern, especially as tyre failure is the leading cause of car crashes worldwide. Artemis can compare the same tyre within 10,000km, 20,000km or 100,000km and predict maintenance issues.

"Our technology is based on a few layers," explains Oren. "The bottom layer is the proprietary hardware which is not something that we develop ourselves in the sense that we do not develop new sensors, or new cameras, or new lighting models. We take these off the shelf. On top of that, we have a few layers of data processing that takes a huge amount of data and separates it into chunks that the deep learning engine can work with.

"On top of that, this is the most important part of what UVeye does, deep learning, or the AI engine, a set of algorithms that we use from computer vision, machine learning, classic image processing, and of course, deep learning to be able to provide visual anomaly detection on different levels on different accuracy and resolution.

"This all sits on our cloud architecture that allows the collaboration of the data between the different inspection points."

The move to the cloud has been a necessity because of the massive increase needed in computing power, going from security applications where resolution wasn't an issue as the anomalies that need locating are large and bulky, to the consumer market where it's

UVeye APPLICATIONS

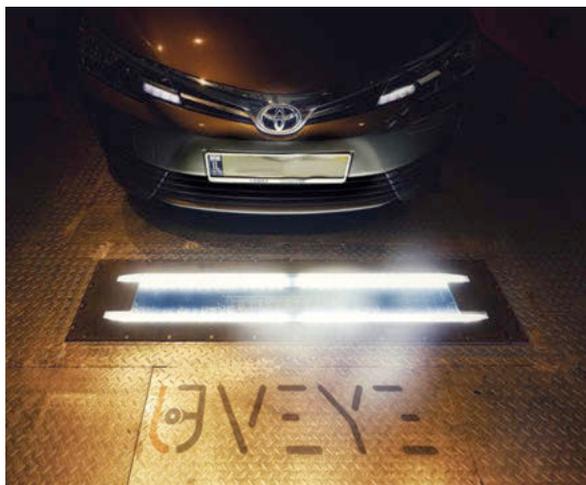
There are a vast number of industries that require Under Vehicle Inspection Systems (UVIS). For example:

- The entrance to prisons – to prevent smuggling and other unlawful activities
- Border control – news headlines are filled with stories of the shocking lengths smugglers are prepared to go to in order to sneak people across borders
- Special occasions – such as diplomatic visits where checking vehicles for suspicious objects is crucial
- The entrance to airports, diplomatic embassies, seaports, power plants, military bases and even shopping mall or hotel car parks



to check the viability of its product in this bigger, more lucrative market. Since working with automotive OEMs, new applications have arisen. One of the big ones was that they wanted to be able to detect damage to or anomalies on the exterior surfaces of the vehicle, not just the undercarriage.

"It grew tremendously," Oren states. "we were able to take the same technology from the software point of view and build hardware for



looking for tiny scratches and part discrepancies.

In future, Oren says that the system could be used in all areas of mobility, such as trains, subways and aviation. However, the short-term goal for the company is to concentrate on growth and R&D in the automotive market.

To this end, the company raised \$31 million (£25m) in July, led by Toyota Tsusho, Volvo Cars W.R. Berkley Corporation and other partners. Amir Hever, UVeye's CEO says: "This is an important signal that we believe paves the way for UVeye to become the standard of automotive inspection and safety. We are delighted to have world-class companies in their respective sectors endorse our game-changing auto scanning solution." 

MOTOR MANAGEMENT

As technology gets smarter and Industry 4.0 becomes more of a reality manufacturers need to move with the times. Here is the Eureka! guide to future-proofing your motor management strategy.

Manufacturers sit at the cutting edge of the Industry 4.0 revolution. Technology is changing the industry as we know it – and manufacturers need to prepare for the impact advancements in tech are set to have. To do so, manufacturers need a clear vision as to how digitalisation is going to impact their sector. Whilst this isn't easy, and there's no set answer, manufacturers can take the opportunity to embrace new and innovative technology. In doing so, they'll benefit from increased insights, and greater productivity. One of the ways they can do this is in their motor management strategy.

"In today's market, the manufacturing industry dominates the industrial sphere," says Martin Walder, VP industry, Schneider Electric. "Within the sector, an incredible volume of power is used to convert raw materials into finished

goods. What's more, more than 60% of the energy in the industry is being used specifically to power motors. Crucially, this is only set to increase for years to come and futureproof the industry."

Whilst this volume of energy consumption may not come as a surprise, Walder says the amount of companies without a motor management strategy in place is surprising. What's more – an intelligent motor management strategy is crucial to reduce overall energy consumption and increase plant uptime. In fact, the manufacturing sector is dependent on motors, so it's essential to ensure that they are protected and fit for purpose now and in the future.

"Think of it like this," Walder adds. "With more and more smart Industrial Internet of Things (IIoT) compatible products available on the



ABOUT THE AUTHOR

*Martin Walder,
VP Industry,
Schneider Electric.*



market, if part of the motor were to break, replacing like for like products would not always provide the best operational results."

WHAT'S WRONG WITH LIKE-FOR-LIKE REPLACEMENT?

Motor starters can be complex pieces of technology – and like all technology, they are at risk of faults, damage or breaking down all together.

There are several different conditions in the industry to watch out for that can create a motor starter failure. This includes, high or low voltage supply, phase unbalance,





By utilising these technologies, product and process information is automatically generated. This allows businesses to open up to the world of plant digitisation and enjoy all the benefits it brings

continuous excessive loading, jam or stall conditions, ground faults, single-phasing, seized motor bearing or binding mechanical linkages.

"When impacted by one of these situations, many plants are re-ordering a like-for-like starter," Walder says. "Prior to its failure, it worked well and it's a product they know and feel comfortable with. This however is a short-term solution.

"The issue here is that the technology and capability of the said motor may not be fit for the long-term. Without smart capabilities,

businesses will suffer from a lack of insight and will get left behind in the plant process information technology race."

SMART MOTOR MANAGEMENT STRATEGIES

The solution, therefore, according to Walder, is to implement a smart motor management strategy. This isn't something that is needed purely for new machines, but also for upgrades and retrofit. A smart strategy offers the manufacturer additional digital based benefits above simply opting to implement energy saving technologies.

"A great example of this in play is Schneider Electric's motor starting product, VSDs and TeSys island with EcoStruxure Machine Expert configuration and commissioning software and the EcoStruxure Motor Configurator tool," says Walder. "The tool helps OEMs to accelerate the time to market by enabling multiple teams to simultaneously programme and control the quality of design. By enabling a more efficient integration, it becomes 40% faster to integrate and reduce installation costs by 30% compared with traditional solutions."

By utilising these technologies, product and process information is automatically generated. This allows businesses to open up to the world of plant digitisation and enjoy all the benefits it brings. Benefits include reduced energy consumption,

increased productivity, more empowered operators, preventative maintenance scheduling and asset management. Not only this, but access to smart data is key in increasing uptime, improving overall quality. All of these contribute to the same end goal – to increase the overall equipment performance (OEE) and ultimately, business profitability.

A FUTURE-PROOF STRATEGY

"At present, a smart motor management strategy may not be the first thing on everyone's minds," says Walden. "But, in three to five years' time, when the senior leadership team are requesting insights into why downtime on the plant floor is high, or into how many stop/starts a motor has done – we need to be prepared to give informed and data-driven answers. The only way to do this is by improving our traditional technology, and replacing it with smarter, more innovative and more connected motors."

The question, he adds, is how do we get the most out of our manufacturing plants? The answer is simple. "It's time to embrace change and opt for smarter, more innovative starter technologies that provide us with the analytics and business insight we are going to need. By preparing a smart motor management strategy now, it's possible to remain competitive, and ready for the future changes technology is yet to bring." 



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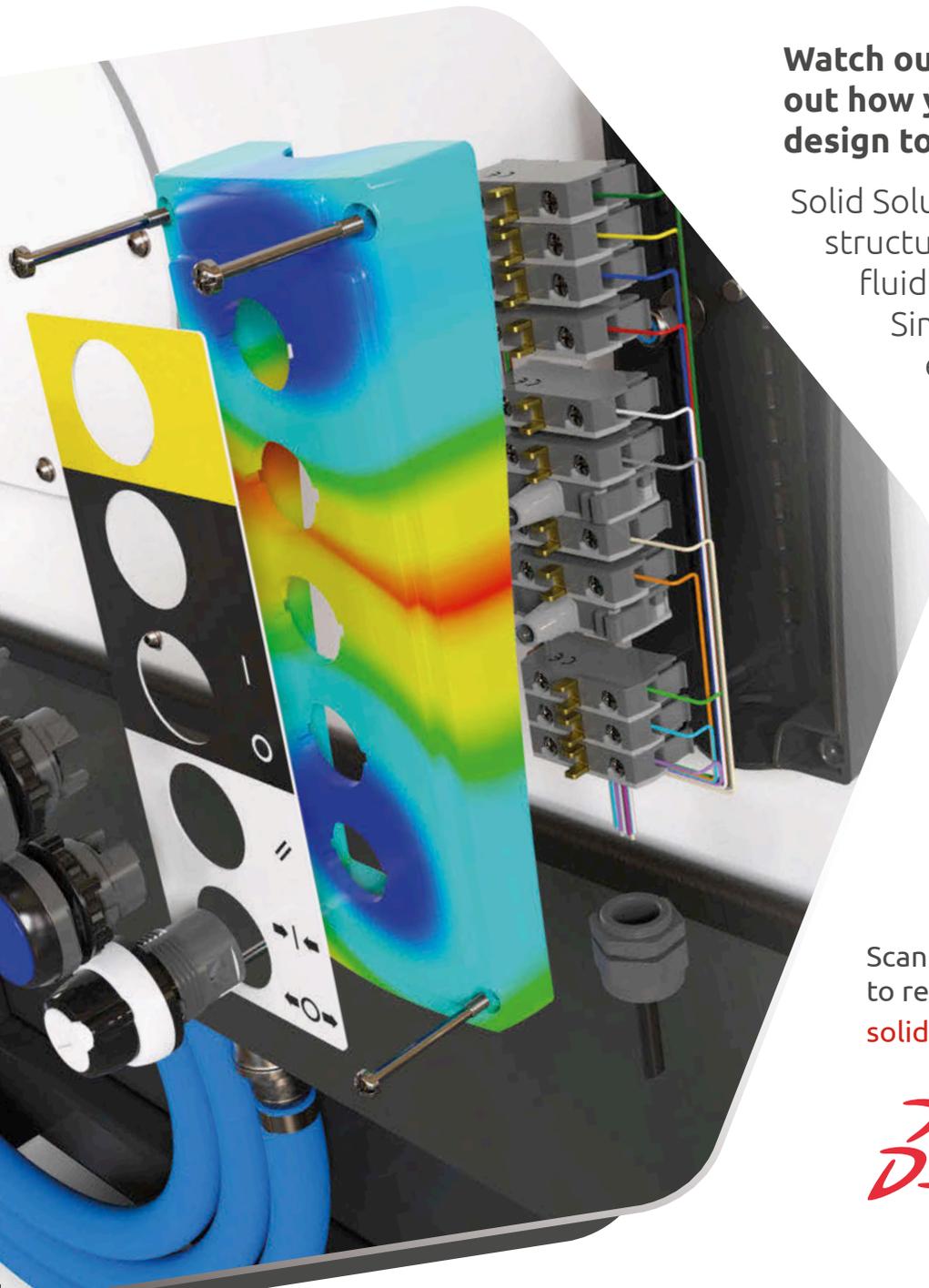
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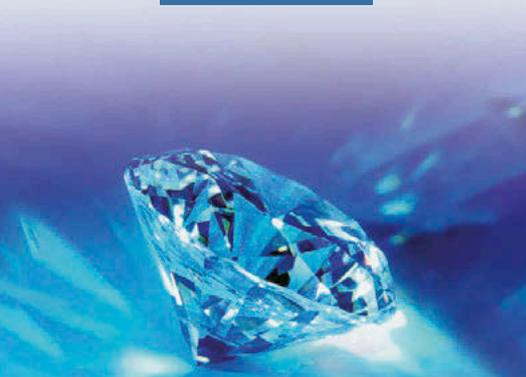
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GRAPHENE MATERIALS FOR SUPERCAPACITORS

First Graphene has signed an exclusive worldwide licensing agreement with the University of Manchester to develop graphene-hybrid materials for use in supercapacitors.

These materials could create a new generation of supercapacitors, for use in applications ranging from electric vehicles to elevators and cranes.

Supercapacitors typically use microporous carbon nanomaterials, which have a gravimetric capacitance between 50 and 150 Farads/g. Research carried out by the University of

Manchester shows that high capacitance materials incorporating graphene can reach up to 500 Farads/g. This will significantly increase the operational performance of supercapacitors in a range of applications, as well as increasing the available supply of materials.

Dr Andy Goodwin, chief technology officer of First Graphene says: "This investment is a direct result of our presence at the Graphene Engineering and Innovation Centre. It emphasises the



importance of effective external relationships with university research partners. The programme is also aligned with the UK Government's Industrial Strategy Grand Challenges and we'll be pursuing further support for the development of our business within the UK."

BUNTING JOINS PMMDA

In recognition of its long association with the plastics sector, the European division of the global Bunting Group has joined the Polymer Machinery Manufacturers and Distributors Association (PMMDA).

Bunting is a designer and manufacturer of magnetic

separators and metal detectors for the recycling and plastics industries.

Established in 1966, the PMMDA provides important information, representation and a mutual support for companies in the plastics industry. The association's activities include exchanging information through

networking and social events; provision of market statistics and industry data; communication of regular business and industry updates; representation and feedback on the development of EU and ISO Standards; and negotiation of member advantage at exhibitions and events.

"Joining the PMMDA reflects the importance of the plastics sector to our business," explained Simon Ayling (pictured, right), MD of Bunting's European division. "After establishing a close working relationship with Renmar Plastic Machinery, director Kevin Horne proposed that we consider joining the association. We are now proud to be members."



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High-speed WELDING

An extreme high-speed laser deposition welding (EHLA) method is capable of coating large-area components at a rate of over 250cm² per minute.

The EHLA method, which is significantly faster than conventional laser deposition welding, was developed and patented by the Fraunhofer Institute for Laser Technology (ILT) with the primary aim of executing coating processes very quickly with low layer thicknesses for rotationally symmetric components. Now, laser system manufacturer, TRUMPF is putting it into series production.

Antonio Candel-Ruiz, an expert for laser surface methods at Trumpf, explains: "For EHLA, we can draw on similar techniques that we've been using for laser deposition welding."

A tried-and-true method in metal coating for many years, laser deposition welding delivers high-quality results. This method makes it possible to manufacture crack-free and virtually pore-free coatings with metallurgical bonding to the substrate out of a variety of materials.

"For large-area coating tasks, however, lasers have lacked the necessary speed," says Candel-Ruiz. In addition, the minimum layer thickness was around 500 micrometres (µm); thinner layers simply were not possible.

How EHLA works

Marco Goebel, Trumpf's industry manager for surface technologies, LMD, explains how laser deposition welding normally works: "We use a laser as a heat source to generate a melt pool, and we inject powder particles

which are molten before the powder particles touch the melt pool on the substrate. By spinning out parts which are predominantly potentially asymmetric very rapidly we are able to deposit very thin, metrologically bonded coatings on the substrate with various kinds of different metals."

Whereas normal laser deposition welding can coat 10 to 40cm² per minute, the EHLA method can achieve rates of over 250cm² per minute. In addition, thinner coatings with layer thicknesses of 10 to 300µm are possible. What's more, EHLA permits a much finer laser focus as well as using higher heat to melt the powder, rendering the process considerably more energy efficient.

One application where TRUMPF is using the EHLA process is on brake discs to make them more durable and stop them shedding fine particles of brake dust that contributes to air pollution. If a hard, corrosion resistant layer is added there is less abrasion and therefore less fine dust. It also means that braking performance may last longer.

"The fine dust produced in our cities is 30% brake dust," says Goebel. "It might come up in the future, and for sure it will come up in

Steel and titanium will not go together. But we can use nearly every metal which is available as a powder for that process

the European Union as a topic, that we have to reduce the fine dust. As always in politics you cannot really foresee when it will happen, but it will definitely happen.

"We strongly believe, and we have indication, that there might be a change in the next couple of years and that will mean that we are quite prepared. The European Union always takes a while, but when the law comes through usually you have to fulfil it immediately and that's why we are preparing."

Goebel goes on to say that there are many other applications in which EHLA can be used. For example, in the mining industry where hydraulic components are under high loads when making and supporting tunnels. Alternatively, in the oil and gas industry where hydraulics are used to keep drilling platforms level under extreme pressures.





These kinds of hydraulic components are 'hard chromed', which is achieved by electroplating. However, there are environmental concerns associated with disposal of the plating solution. EHLA is seen as a viable alternative.

"The advantage over hard chrome is you can deposit very thin layers from 50µm up to several millimetres, but usually we are fine with 200 or 300µm," explains Goebel. "By doing that and by having a large selection of alloys which you can use and deposit on the material, which are ready to use and are nearly all qualified, you can create metrologically dense, diffusion dense layers to provide perfect corrosion and wear resistance that can be combined together and this is, for us, a very interesting new technology to look into where we can use our lasers and our expertise in the material process."

Yet another advantage, Goebel says, is that



the bonding strength of the coating will usually be at least on the same level as the substrate. For example, a steel substrate could be coated in steel powder, it will have the tensile strength of steel, so it will be extremely hard to remove. Metals that are considered too soft for certain applications – for example 316L stainless steel, which is austenitic – can also be hardened by around 50% due to EHLA's rapid heating and cooling cycles. No extra chemicals are used to do this, and any powder overspray can be recycled and used again.

"Of course, there are certain limits," says Goebel. "Steel and titanium will not go together. But we can use nearly every metal which is available as a powder for that process. We are still qualifying new materials."

"Of course, there are certain limits," says Goebel. "Steel and titanium will not go together. But we can use nearly every metal which is available as a powder for that process. We are still qualifying new materials."

Available EHLA systems

Candel-Ruiz adds: "Our diode lasers and our disk lasers are suitable for EHLA, depending on the laser focus required." With diode lasers, a focus of around 1mm is possible; with

disk lasers, a focus as small as about 0.2mm. In addition to the laser beam source, another decisive factor is that the machine has a rotational axis that permits high speeds.

Depending on component size, Trumpf has various laser machines that are candidates for EHLA. The TruLaser Cell 3000 is suitable for small and medium-sized components, while the machines in the TruLaser Cell 7000 Series are suitable for large ones. Apart from these turnkey systems, manufacturers can integrate the EHLA method into their existing systems. The DepositionLine technology package from TRUMPF can also be equipped with powder feed nozzles developed by Fraunhofer ILT.

Looking forward Goebel says: "We are looking down several avenues. Of course, we are trying to be more productive. Going faster is definitely a goal for us, but what we'd really like is to have the high-speed laser cladding process in operation in as many applications as we see. And we of course try to enhance our system equipment so that the process will get even more flexible, for instance being able to do some high-speed cladding even on a 90° angle which is right now not feasible. So, in short: getting faster, more productive, more production, getting into more applications and enhancing our system technology." 



As an advanced motion control technology distributor and manufacturer, McLennan supplies and fully supports a wide range of precision motion control components from its distribution partners - and also has the capability to combine these products with its own design and build service for bespoke and turn-key motion sub-systems - for applications across industry and research.

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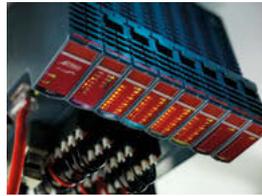
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Trio Motion's Flex-6-Nano is a powerful integrated EtherCAT servo/stepper controller for high-speed synchronised motion and machine control. Available from 2 to 64 axes and with additional motion expansion through add-on axis modules, the din-rail mounted system also takes care of machine I/O and supplementary motion through Trio's modular Flexslice digital and analogue input, output and axis expansion modules.

Danish motion controls designer and manufacturer, JVL has enhanced its range of EtherCAT motion control modules for servo and stepper integrated motors to include the CiA402 drive profile. This brings millisecond-level motion and machine synchronisation capability with extremely low jitter for demanding high-speed automation tasks.



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Tuneable bioplastics

Plastics pose a problem for the planet – from the fossil fuels used to produce them to the harmful chemicals released during their slow degradation. But plastic is so ubiquitous that giving it up presents a complex challenge.

Plastic has become such an integral part of life in the Western world that it's often easy to forget that the material was only invented in the 19th century. This is just as well, as many of the durable plastics in single-use products, such as bottled water and six-pack rings, can take up to 450 years to degrade. Today, we could probably find remnants of the first plastics ever manufactured still laying in landfill or floating in our oceans.

The longevity of plastics wouldn't be as acute a problem if it weren't for the scale of their use. Polymers are remarkably versatile materials, boasting wide-ranging characteristics from durability and stiffness to tensile strength and flexibility, depending on the specific polymer used. This versatility means plastics feature everywhere from structural reinforcement to disposable packaging.

In March 2019, the Ellen MacArthur Foundation published its New Plastics Economy report, which noted that 8 million tonnes of plastic packaging is produced every year by 30 global brands. Almost 50% of this packaging was produced by Coca Cola, totalling three million tonnes. Much of this packaging will be single use, so the majority of the eight million tonnes produced this year will be plastic pollution next year.

The problem goes much further than just a build-up of waste plastic cluttering the land and sea. Because plastic is a man-made material, it is generally difficult to break down naturally. For most naturally occurring materials, decomposition occurs because bacteria consume the larger material and break it down into smaller, useful compounds.

Breaking the chain

Unless they are recycled or incinerated, plastic products that are discarded end up in one of two places. They are either disposed of with general waste and destined to reside in landfill, or are thrown away as litter, which can then wind up in the oceans. According to figures published in *Science* in 2015, anywhere between 4.8 and 12.7 million tonnes of plastic finds its way to sea every year.

"For the tonnes of plastic that are washed away into the ocean, ultraviolet radiation from the sun is the main factor influencing degradation," explains Dr Ashlee Jahnke,

According to figures published in *Science* in 2015, anywhere between 4.8 and 12.7 million tonnes of plastic finds its way to sea every year

director of research at renewable polymer producer Teysha Technologies (pictured). "The decomposition process of plastic involves the long, complex polymer chains of the material being separated into smaller chains through a process known as chain scission, whereby the linkages holding the atoms of the material together break."

Although it can take more than 450 years for plastic to fully degrade, the process of chain scission happens at a much faster rate, with the first chains breaking in under one year.

In our oceans, this poses two fundamental problems. The first is that the smaller the polymer



Theoretically, developing biodegradable plastics means that it's easy to solve the plastics problem

debris is, the easier it is for organisms to ingest. The second problem posed by plastic degradation in our waters is that of the chemicals produced during chain scission.

For the plastics that stay on land and are buried in landfill, the process of degradation is similar. As many pieces of plastic waste in landfill will not be exposed to sunlight or UV radiation in the same way as sea plastics, the factor affecting degradation is heat.

"As a dumping ground for waste, landfills contain a mix of many types of solid waste, most of which does not have the same trouble degrading that plastics do," Dr Jahnke continues. "As these products deteriorate, the chemical reactions that occur lead to an elevated temperature, which can contribute to polymer breakdown. However, the same problem of potentially toxic chemical leakage persists, which can easily enter soil and make its way back into our food chain over time."

Nature finds a way

Plastics and plastic pollution are among the top problems facing the planet and life as we know it today. As such, researchers around the world have been vehemently searching for a solution, which led to the development of bioplastics and biodegradable plastics.

Dr Jahnke says: "Often confused, bioplastics are based on naturally occurring components, either entirely or in part, whereas biodegradable plastics are any plastic that can be completely broken down naturally to accepted industry standards. Generally, all biodegradable plastics are bioplastics, and that is why naturally occurring microorganisms can consume them, unlike fossil-fuel derived plastics.

"Theoretically, developing biodegradable plastics means that it's easy to solve the plastics problem. We simply need to move away from



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unsustainable plastics and adjust manufacturing processes to use naturally occurring, safely biodegradable polymers instead. Of course, this is not the pragmatic approach."

The reason why plastic in its current form has proven so popular is its versatility. It can be soft, flexible and malleable where the application needs it, or it can be developed in a way that makes it highly durable and rigid. Biodegradable plastics have so far lacked this versatility, limiting the scope of their application.

"But now, we're on the precipice of change in the industry," Dr Jahnke says. "Following years of research, Teysha Technologies has achieved a landmark breakthrough in creating a viable substitute for existing petroleum-based polycarbonates.

"The breakthrough is more of a platform than a single polymer system, providing inherent versatility in the properties that can be achieved. It can be thought of as a plug-and-play system where various modified natural-product monomers and various co-monomers can be

used. In addition to co-monomers, various additives can be used to modify the properties of the final polymer produced. This versatility allows for the formation of a variety of materials that can vary greatly in their thermal and mechanical properties."

Because the platform facilitates the use of various components, everything from strength and toughness to thermal stability and even the degradation rate of the material can be controlled.

"This is the pragmatic solution for consumers, material scientists and design engineers alike," Dr Jahnke states. "Not only does it accommodate for the existing lifestyle of the end user, but it also allows materials scientists to create something that serves as a desired, drop-in replacement for petroleum-based plastics.

"Traditional plastics might pose a problem for the planet, but tuneable plastics could offer a viable solution that lets us sustain life as we know it." 

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ALL THE GEAR...

A view of some of the latest gearbox technologies that increase performance and efficiency to have reached the market.



There have been a number of developments in the field of industrial gearboxes that offer designers improved options in terms of performance and efficiency.

Among these is a new range of right-angled planetary gearboxes is now available from Motor Technology for a wide range of industrial applications. Manufactured by Italian firm, Tramec, the TEP range is based on the company's long-established EP range of general-purpose planetary gearboxes.

Right-angled gearboxes are frequently used where there are space constraints on a machine, often machines with high axis counts, such as slitters and winders, printing and packaging machines, handling and robotics, etc.

Currently available in four frame sizes, 55, 75, 90, and 120, in one and two stage configurations. Single stage versions offer ratios from 3:1 to 10:1, and two stage versions offer ratios from 12:1 to 100:1.

Backlash ranges from 12-17 arcminutes for the single stage and 15-20 arcminutes for the two-stage versions.

As well as robotics and factory automation, applications for the versatile motors include electronic and semiconductor equipment, medical equipment... laser processing and spray-painting equipment

Gearbox efficiency is 94% for the single-stage type and 91% for the two stage.

The gearboxes also perform well in terms of noise generated during operation with levels between 65 to 70dB at 3000rpm input speed. Gearbox output torque is up to 180Nm nominal, 290Nm peak, and with an E-Stop torque of 600Nm.

The gearboxes are flange compatible with Tramec's EP series

and also offer alternative shaft and output flange options. A wide range of motor adapters are available for typical servo, stepper, DC and AC motors.

Another innovation comes from Motion Control Products, which has introduced compact high torque motors with integral strain-wave (harmonic) gearboxes.

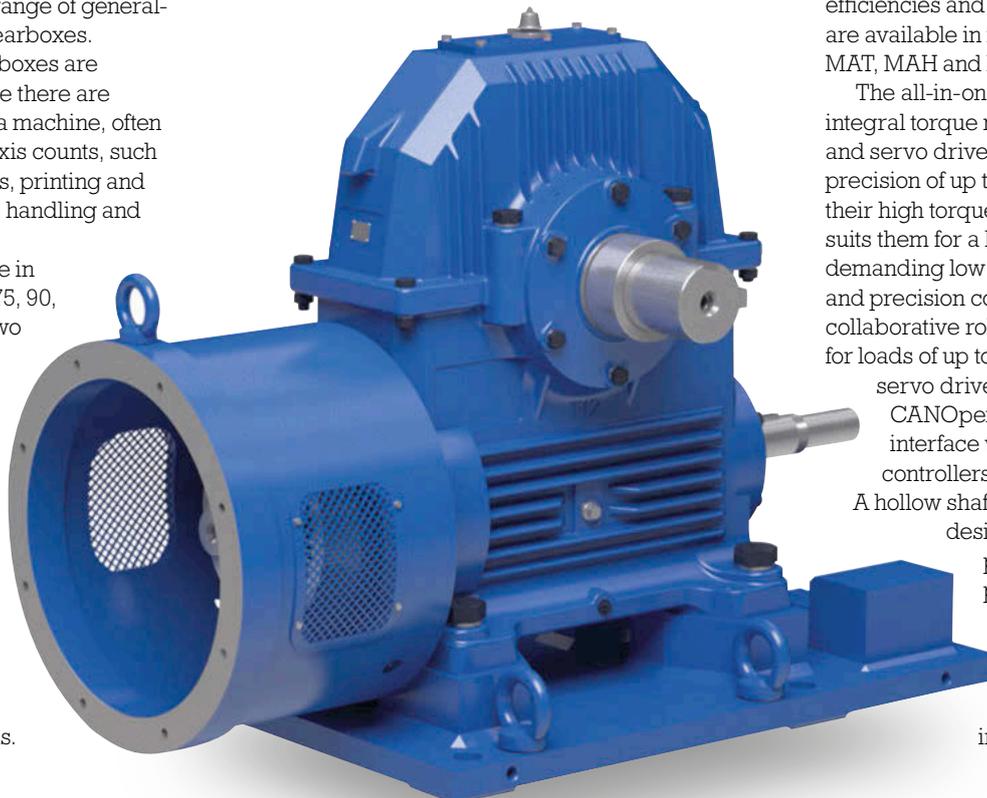
Offering high levels of torque and precision, the latest torque motors have an integral strain wave (harmonic) gearbox. With high efficiencies and compact sizes, they are available in four series: MAS, MAT, MAH and MGM.

The all-in-one MGM series has an integral torque motor, encoder, brake and servo drive. Delivering a high precision of up to 60 arcseconds, their high torque of up to 557Nm suits them for a host of applications demanding low noise, high torque and precision control, such as collaborative robot applications for loads of up to 25kg. Integrated

servo drives for EtherCAT or CANOpen enable the units to interface with most mainstream controllers on the market.

A hollow shaft simplifies system design by allowing the passage of cables, pipework etc.

The other series of low-cogging, low noise motors have an integrated strain wave





gearbox and frameless motor with a range of encoder options. One series is the MAH, which has a standard hollow shaft and frame sizes from 60mm to 145mm diameter. Rated torques of up to 800Nm are available and precision is up to 30 arcseconds.

The MAT series has a wider hollow shaft and offers a precision of up to 40 arcseconds, while the MAS series have a solid shaft and a precision of up to 50 arcseconds.

Across the whole series, all the models are flexible, reliable, low maintenance and compact. Gear ratios are available from 51:1 to up to 161:1. All models are fully enclosed and self-cooled and can be specified with IP67 ingress protection when operation is required in harsh environments.

Standard input voltages are 48VDC, 110VAC and 220VAC, and input voltages can be customised on request, as can the torque, etc.

As well as robotics and factory automation, applications for the versatile motors include electronic and semiconductor equipment, medical equipment, precision measuring instruments, machine tools, laser processing and spray-painting equipment.

Renold Gears has launched a leak-free technology kit for heavy-duty gearboxes that can either be supplied with new units or retrofitted to existing ones.

After a lengthy development process, extensive testing of

a gearbox fitted with the new technology showed that all components received sufficient lubrication and, most importantly, without any oil leakage. The operational temperatures were also found to be significantly lower, indicating reduced power losses of up to 14%.

Overall the results of the tests showed that the new solution operated better than the standard configuration. After delivery to Tubelines a gearbox fitted with the new leak-free kit passed all testing protocols and was eventually installed on an escalator where it has been operating satisfactorily at a busy station without any issues.

Commenting on the project, Roger Godson, of Renold Gears, said: 'We're very proud to have been invited to develop a leak-free gearbox solution for Tubelines and to have made a contribution to significantly reducing the maintenance of escalator drives on the London Underground.'

Whilst initially designed for heavy load escalators at underground stations the new leak-free gearbox technology is perfectly suited to a wide range of heavy-duty industrial applications including, conveying, mining and quarrying, cement manufacture, pumping, water and wastewater treatment, metal manufacture and power generation, etc. 

NEW MANUAL GEARBOX ENABLES CO₂ SAVINGS

Volkswagen has developed a new state-of-the-art manual gearbox: The MQ281, as it is known, works efficiently and saves up to five grams of CO₂ per kilometre depending on the engine-gearbox combination. The new Passat is the first vehicle to be equipped with the MQ281, followed by almost all vehicle classes of the Volkswagen Group.

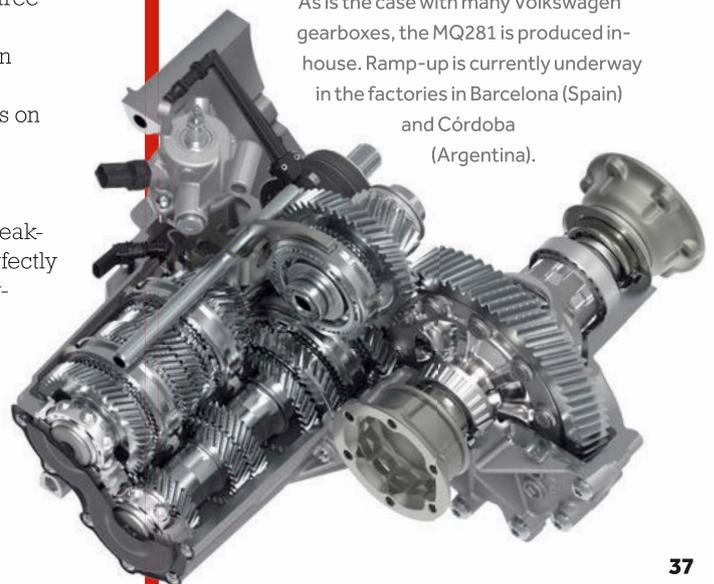
Only slight modifications were sufficient to improve efficiency and consumption with a huge impact on emissions and the environment. Although they function unobtrusively, manual gearboxes have a significant share of the gearbox market worldwide due to a high installation rate.

The trend towards vehicles from the SUV segment with large-diameter wheels places high demands on the gearbox. "With the MQ281, we have developed a highly efficient manual gearbox that reliably meets these demands – and is soon to be introduced into a number of vehicle classes in the volume segment," explains Helmut Göbbels, head of manual gearbox and four-wheel drive development at Volkswagen. The MQ281 has a torque spectrum of 200 to 340 newton metres, which means it completely or partially supersedes the current Volkswagen gearbox designs with the internal designations MQ250 and MQ350 respectively.

It is based on a 2.5 shaft concept and boasts a high gear spread of maximum 7.89. On the one hand, this guarantees good driving off performance – even for heavy vehicles with large wheels – and facilitates, on the other hand, "downspeeding", which is (fuel-saving) driving in high gears with low engine speed.

Material use and its distribution for the gearbox housing was also optimised. With the aid of a further virtual development tool, a strength-optimised housing structure could be designed. The new housing supports the noise requirements of today (avoidance of undesired secondary noises) and therefore ensures improved driving comfort through less audible and noticeable vibrations in the vehicle.

As is the case with many Volkswagen gearboxes, the MQ281 is produced in-house. Ramp-up is currently underway in the factories in Barcelona (Spain) and Córdoba (Argentina).



10TH ANNIVERSARY BEEAS

british engineering excellence awards

A DECADE OF EXCELLENCE

The British Engineering Excellence Awards has charted the breadth and depth of talent in the UK's design engineering community for the last 10 years. Over the last decade the BEEAs has gone from strength to strength, as has the quality of the entries.

The ten-year anniversary of the British Engineering Excellence Awards (BEEAs) was held in the luxurious surroundings of The Landmark London on Friday 11 October where robotics start-up Automata was named the winner of the Grand Prix prize.

Automata is on a mission to democratise robotics. Founded in 2014 by architects Mostafa ElSayed and Suryansh Chandra, the company was born out of the need to find a cost-effective approach to industrial automation when the only options available were prohibitively expensive industrial robots, or basic robot arms sold on Amazon that are little more than toys.

The work of Automata could change all that. The company's Eva robot is affordable and easy-to-use, while also being fit-for-purpose in an industrial context.

Having launched commercially in March 2019, the company has now

surpassed 150+ orders, with many happy customers with successful deployments who are now making repeat multi-unit orders.

In honour of it being the tenth anniversary of the BEEAs, a Design Engineer of the Decade category was awarded. This saw every previous winner of Design





Engineer of the Year pitted against one another to decide on 'the best of the best'. The winner of this prestigious prize was Sebastien Cuvelier Mussalian, who won in 2013 for his work as lead engineer on the OrganOx perfusion system, which keeps donor human livers 'alive' before being transplanted.

Since then, Sebastien has gone on to build an international reputation for the design, development and industrialisation of innovative, robust medical devices. The judges were keen to recognise his contribution to the industry; his ability to handle complex, multidisciplinary projects; and the truly global impact of his work.

Luke Webster, publishing director of awards organiser MA Business, said: "A decade on from its beginnings, this year's British Engineering Excellence Awards winners are evidence that British engineering is still producing superb companies, products, projects and people. Through every category, the judges were deeply impressed by the quality of engineering put forward and the talent behind it. I congratulate all those entrants that were shortlisted and of course the winners."



BRITISH ENGINEERING EXCELLENCE AWARD WINNERS 2019

SMALL COMPANY OF THE YEAR: INNOVATIVE PHYSICS

Sponsor: Analog Devices

Operating in the nuclear, medical, and homeland security industries, Innovative Physics evolves current technologies to provide novel solutions to radiological obstacles for the benefit of customers and society.

Highly Commended: Precision Acoustics



START-UP OF THE YEAR: AUTOMATA

Sponsor: SolidWorks

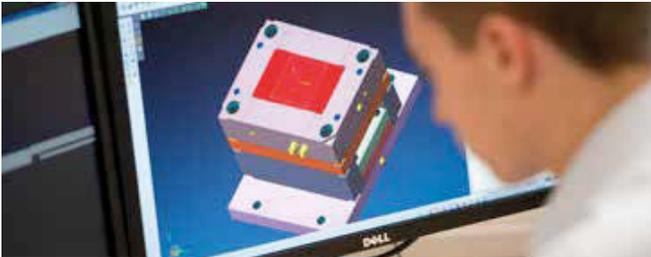
With its mission to democratise robotics, Automata impressed the judges with its development and launch of the Eva robot, which combines ease-of-use and affordability with fitness for purpose in an industrial context.





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**DESIGN TEAM OF THE YEAR:
EARTHSENSE & BLUEFROG
DESIGN**

Sponsor: LG Motion

Working alongside air quality expert EarthSense's electronics engineers, Bluefrog Design developed the Zephyr; a compact and robust air quality sensor. Packaging innovative electrochemical sensors and optical particle counters within a highly cost-effective product that is engineered to perform accurately across global climates and designed to measure pollution, temperature and humidity in the urban environment.



The ceremony was hosted by Professor Lucy Rogers

**MATERIALS APPLICATION OF
THE YEAR: AIXAL BRAKE ROD –
ALVANT**

Sponsor: Goodfellow (Cambridge)

A two-year, £28m project, titled 'Large Landing Gear of the Future' has seen Aluminium Matrix Composites (AMC) manufacturer, Alvant, team up with high-technology group, Safran Landing Systems that could reduce landing gear weight by as much as 30%, assisting with the aerospace industry's drive to reduce fuel consumption and carbon emissions.

**NEW PRODUCT OF THE YEAR
(ELECTRONIC): QUANTA
DIALYSIS TECHNOLOGIES – SC+**

Sponsor: New Electronics magazine

Developed by Quanta Dialysis Technologies, SC+ is a small, simple and powerful haemodialysis system designed to provide greater flexibility around where, when and how patients manage and receive their dialysis therapy.



**NEW PRODUCT OF THE YEAR
(MECHANICAL): BOWMAN
POWER – ETC 1000**

Sponsor: MiniTec

In addition to the low cost of power creation it offers, the ETC 1000 genset from Bowman Power can achieve up to a 10% increase in total electrical power; a 23% reduction in greenhouse emissions; a 40% reduction in unburnt hydrocarbons; a 7% reduction in fuel consumption; and a 50% reduction in pre-heated engine load ramp time.

Highly Commended: Russell Finex – AMPro Sieve Station

**ENGINEERING AMBASSADOR
OF THE YEAR: LAURA
GIDDINGS, RS COMPONENTS**

Sponsor: Eureka! Magazine

An inspiring ambassador for engineering, in her role as education events manager for RS Components, Laura Giddings has achieved tangible results in improving perceptions around engineering, inspiring young people to pursue it as a career and helping educators with valuable and dynamic resources to bring STEM subjects to life in the classroom.

**YOUNG DESIGN ENGINEER OF
THE YEAR: JAMES VEALE, GB
INNOMECH**

Sponsor: RS Components

In less than two years since joining automation consultancy GB Innomech as a project engineer, James Veale has helped the company to develop its first product line which has been subsequently spun out in a separate company called GiroNEX.

**DESIGN ENGINEER OF THE
DECADE: SEBASTIEN CUVELIER
MUSSALIAN**

Sponsor: SolidWorks

Entrants in this category were the previous winners of all the Design Engineer of the Year Awards. Sebastien Cuvelier Mussalian was the winner, having won in 2013 for his work as lead engineer on the OrganOx perfusion system, which keeps donor human livers 'alive' before being transplanted. Since then, Sebastien has gone on to build an international reputation for the design, development and industrialisation of innovative, robust medical devices.

**CONSULTANCY OF THE YEAR:
DRIVE SYSTEM DESIGN**

Sponsor: MA Business

The tale of Drive System Design's success can be told via its statistics. Since 2014, it has doubled its UK based employee headcount to 96 full-time employees and significantly grown its US office from four to more than 30 employees. In addition, during 2019, the company identified significant opportunities in Asia, and is in the process of launching within this market, specifically in Korea where representation has already been established.

Highly Commended: ByteSnap Design

GRAND PRIX 2019: AUTOMATA

Sponsor: Distrupol

What the judges said: "[Automata is] a company determined to democratise the use of robotics among small businesses and, with over 150 orders, it's well on course to achieving this ambition."

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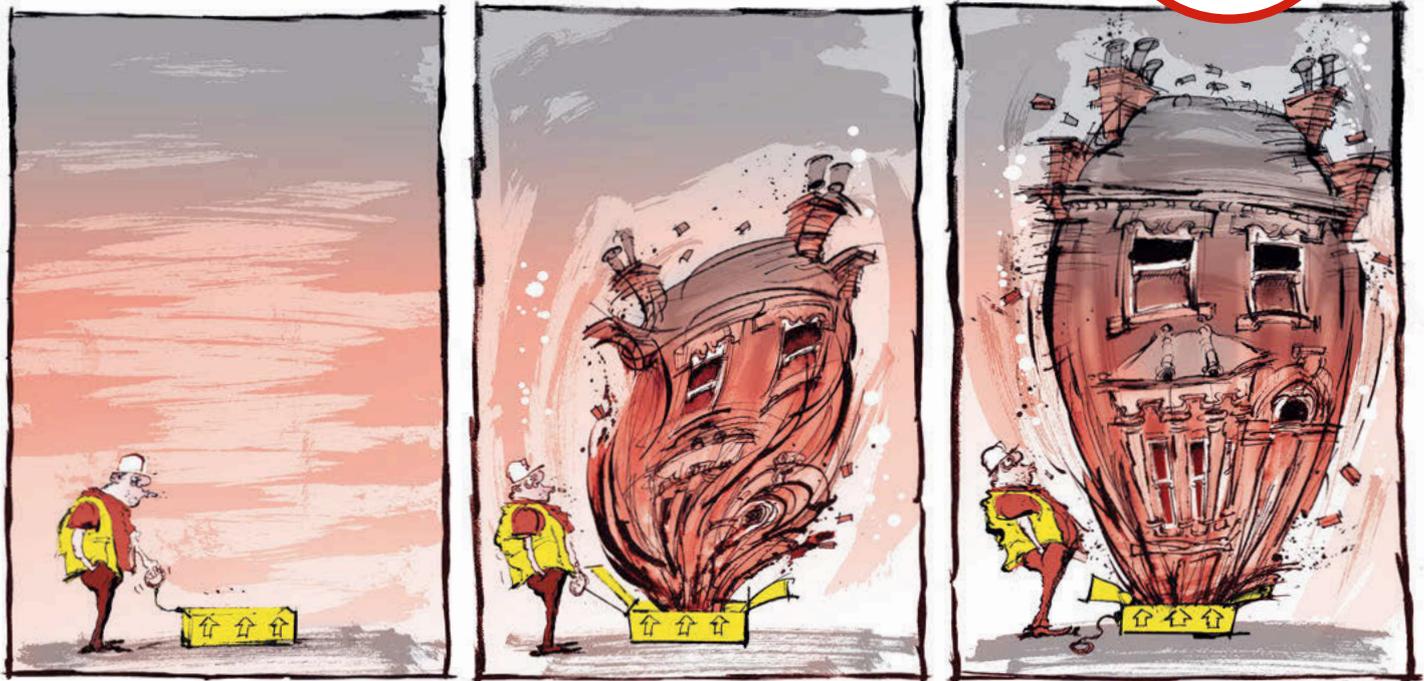


FAST DESPATCH



FREE SAMPLES

HOUSING CRISIS



There are 25.9 million refugees in the world today, and the World Bank projects that 143 million people will be forcibly displaced by 2050. To house this tremendous number of vulnerable people is a monumental challenge.

The dilemma is not only related to materials but to points of view: refugee camps are currently regarded as temporary installations. Yet, in certain refugee camps, such as Dadaab in Nigeria, many people have stayed for over 20

years – an entire generation.

Living in exposed makeshift tents that are replaced every six months renders the current situation deeply flawed in terms of cost, sustainability, and living standards. More and more camps are long term residencies and, some suggest, should be considered the foundations

for new cities – sites to reintegrate displaced people and to rebuild thriving communities.

THE CHALLENGE

Along these lines, the challenge this month is to design a permanent or semi-permanent dwelling to house refugees who are spending longer and longer in makeshift camps, with the aim

of increasing their quality of life.

The constraints include that the dwelling must be cheap, easy to install and maintain, and able to last for many years in various weather conditions. You may also want to think about what materials to construct it from, innovative supporting structures and fixings as well as security and what amenities you would include. 🚫

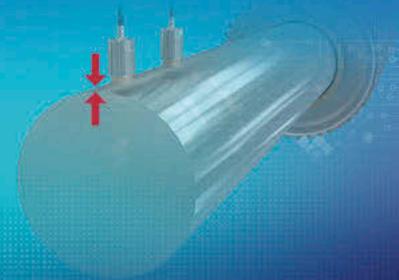
The idea we have in mind will be revealed in the **December** issue of Eureka! Until then, see what you can come up with. Submit your ideas by leaving a comment on the **Coffee Time Challenge** section of the Eureka! website or by emailing the editor: paul.fanning@markallengroup.com

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- Wide range of applications with more than 400 sensor models
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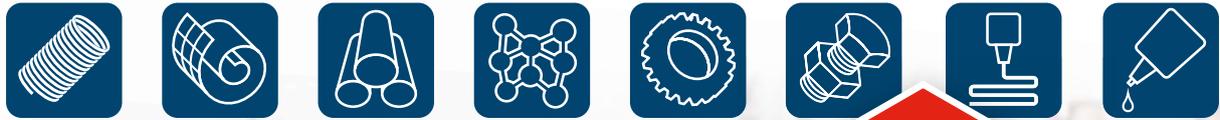


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